

U90W0R0MTUS
X

**Abundance and Distribution of Bats in the
Pryor Mountains of South Central Montana**

David J. Worthington

Division of Biological Sciences
University of Montana
Missoula, MT 59812-1002

and

H. Nelson Ross

Montana Nature Conservancy
1515 East Sixth Avenue
Helena, Montana 59620

for the

Montana Natural Heritage Program
Bureau of Land Management - Billings Resource Area
Custer National Forest

May 1, 1990

CONTENTS

Table of Contents.....	1
List of Tables.....	2
Acknowledgements.....	3
Summary.....	4
Introduction.....	5
Study Area.....	6
Methods.....	6
Results.....	7
Water Sources.....	8
Caves.....	12
Discussion.....	16
Recommendations.....	17
Literature Cited.....	19

LIST OF TABLES

<u>Number</u>	<u>Page</u>
1 Bats occurring in the Pryor Mountains.....	5
2 Terrestrial ecosystems of the Pryor Mountains.....	6
3 All bat captures, 1989.....	8
4 Bats captured at Gyp Spring.....	8
5 Bats captured at Sage Creek campground.....	9
6 Bats captured at Indian Springs.....	10
7 Bats captured at Sage Creek work station.....	10
8 Bats captured at Twin Hills guzzler.....	11
9 Bats captured at Crooked Creek.....	11
10 Bats captured at Mystery Cave.....	13
11 Bats captured at Little Ice Cave.....	14
12 Sex and Chi-square values for bats captured at Mystery Cave and Little Ice Cave.....	15

ACKNOWLEDGMENTS

Funding for this study was provided by the Montana Natural Heritage Program (MTNHP) and The Nature Conservancy. Additional support for D. Worthington was received from the American Museum of Natural History and the University of Montana (UM). The Bureau of Land Management (BLM) Billings Resource Area provided transportation, housing, and support. Special thanks to Bill McIlvain (BLM) and David Jaynes (BLM) for their assistance and cooperation. The Beartooth Ranger District of the Custer National Forest provided housing and support. Terry Peters of the National Park Service assisted in the investigation of the Bighorn Canyon National Recreation Area. David Genter (MTNHP) and Kerry Foresman (UM) provided overall supervision of the study and extensive comments on this report. Richard Hutto (UM) and Dan Pletscher (UM) provided advice on the study design. Mike Bogan of the National Ecology Center, U.S. Fish and Wildlife Service, provided valuable advice on the study and on bat biology in particular.

SUMMARY

This report documents the results of a study of bat occurrence in the Pryor Mountains of south central Montana. The field research was conducted from 15 June to 10 September, 1989. Bats were captured in mist nets set over ponds, streams, and springs and at the entrance of two caves. Numbers of bats captured were greatest at Little Ice Cave and at Mystery Cave. Capture success was considerably lower at water sources, but a greater diversity of species were captured at these sites, particularly at Sage Creek campground and Gyp Spring. Most of the species captured occurred throughout the area, with the exception of the pallid bat, Antrozous pallidus, and the silver-haired bat, Lasionycteris noctivagans, which were more restricted in distribution. Eight individuals of Antrozous pallidus were captured at Gyp Spring. This species was known previously in Montana from only one specimen taken at Gyp spring (Shryer and Flath, 1980). Of the eight individual pallid bats netted in 1989, four were lactating females, indicating that this species breeds in Montana. Several of the species of bats found in the Pryor Mountains were captured in numbers significantly different from an expected 1:1 sex ratio. This was especially true at Mystery Cave and Little Ice Cave, suggesting that in some species, males and females may be differentially utilizing habitat. Bat activity at both Mystery Cave and Little Ice Cave indicated that these caves provide important summer roosting habitat for bats. Additionally, both caves possess characteristics which may make them important as hibernacula.

INTRODUCTION

Ten species of bats are known to inhabit the Pryor Mountain area (Hall, 1981; Shryer and Flath 1980; Hoffmann and Pattee, 1968; Table 1). Two of these, the spotted bat (Euderma maculatum) and Townsend's big-eared bat (Plecotus townsendii), are listed under category 2 as candidates for the Endangered Species Act (Federal Register, 1987). Plecotus townsendii and Euderma maculatum are listed as sensitive species by the Forest Service (USFS) in Region 1. The pallid bat, Antrozous pallidus, together with the previous two species, is listed as a species of special concern by the Montana Natural Heritage Program (MTNHP, 1989). The first specimen of Antrozous pallidus from Montana was collected by Shryer and Flath (1980). Eight additional specimens were observed during the summer of 1989. Plecotus townsendii has been found in hibernacula during winter in the study area (D. Genter, per. comm.), and two specimens of Euderma maculatum are known from the eastern edge of the Pryor Mountain's in the Bighorn Canyon National Recreation Area (BCNRA) (T. Peters, per. comm.). Neither Plecotus townsendii nor Euderma maculatum were observed during 1989.

TABLE 1.--Bats Occurring in the Pryor Mountains.

<u>Myotis lucifugus</u>	little brown myotis
<u>Myotis ciliolabrum</u>	western small-footed myotis
<u>Myotis evotis</u>	long-eared myotis
<u>Myotis volans</u>	long-legged myotis
<u>Eptesicus fuscus</u>	big brown bat
<u>Antrozous pallidus</u>	pallid bat
<u>Lasiurus cinereus</u>	hoary bat
<u>Lasionycteris noctivagans</u>	silver-haired bat
<u>Plecotus townsendii</u>	Townsend's big-eared bat* **
<u>Euderma maculatum</u>	spotted bat **

* winter records only

** not observed during the 1989 field season

Tuttle and Stevenson (1978) suggest that those caves that possess structural and elevational complexity and a wide thermal range provide the greatest diversity of roosting sites. Tuttle (1979) found that of 1635 known caves in Alabama, only 2.4% were used by gray bats (Myotis grisescens) in summer, and only .1% used in winter. While caves are numerous in the Pryor mountains, most are small and horizontal (Cambell, 1978). The few large caves found in the area may be of primary importance to bats.

Of the many caves known in the area, one is known to have been used as a hibernaculum by Plecotus townsendii (D. Genter, per. comm), and two of the larger caves were found to be occupied by four species of Myotis during the summer of 1989.

The Federal Cave Resources Protection Act of 1988 mandates that federal agencies identify significant caves and manage for their protection. The caves discussed in this report may warrant such management, and the information gathered from this study will assist the federal agencies involved in management of the Pryor Mountain area in making management decisions for those caves and their resources.

STUDY AREA

This study was conducted in the Pryor Mountains, approximately 72 km south of Billings, Montana. The area is primarily federal in ownership, and administered by the Bureau of Land Management, the Custer National Forest, and the National Park Service. The Crow Indian Reservation borders the northern portion of the area, and small portions of private land are dispersed throughout the area. The area ranges in elevation from approximately 1500 m to over 2600 m, and encompasses approximately 500 square km. Nine terrestrial ecosystems have been described in the Pryor Mountains (South, 1979; Table 2), ranging from low elevation red desert salt shrub to subalpine plateau found at higher elevations. Vegetative and ecological descriptions in this report are based upon those descriptions.

TABLE 2.-- Terrestrial Ecosystems of the Pryor Mountains

-
- 1) Subalpine Plateau
 - 2) Subalpine Forest and Meadow
 - 3) Douglas Fir
 - 4) Rock Outcrop
 - 5) Mountain Grassland
 - 6) Streamside Hardwood
 - 7) Utah Juniper-Blacksage
 - 8) Sagebrush-Grasslands
 - 9) Red Desert Salt Shrub
-

METHODS

Bats are most successfully captured over calm water sources (Kunz and Kurta, 1988; von Freckell and Barclay, 1987), especially over ponds or near the entrance of caves or mines used as roosting sites (Griffith and Gates, 1985). Water sources were identified

using US Geological Service (USGS) topographic maps and ground searches. Caves and mines were located using USGS maps and "Caves of Montana" (Cambell, 1978). Bats were captured at water sources and caves using one or more 1 1/2 " mesh mist nets 5.5 or 9 m long. Since bats may become more effective in avoiding nets on subsequent nights of trapping (Kunz, 1973; Laval, 1970; Kunz and Kurta, 1988), net configurations and positions were altered from night to night, and an attempt was made to avoid netting at the same site on two or more successive nights. Mist nets were deployed shortly after sunset when bat activity commenced, and were either dismantled three to four hours later or left deployed through the night until dawn.

All captured bats were identified to species, and sex and reproductive condition was assessed via visual examination and manual palpation (Racey, 1988). Age was determined via visual examination of epiphyseal-diaphyseal fusion of wing bones. Body mass was determined by placing bats in a small plastic bag and weighing them using a 50 gm Pesola scale. Forearm length was measured using dial calipers. Capture time and weather conditions were recorded. Except for those bats captured during the first three weeks of the study, bats were marked using color and number coded split-plastic wingbands (Barclay and Bell, 1988) to facilitate identification upon recapture.

RESULTS

Seven caves and ten water sources were investigated for bat activity. Bats were captured on 40 nights at 10 of 13 locations that were netted, between 15 June and 10 September 1989. A total of 316 bats were captured representing eight species (Table 3). Only one marked bat was recaptured.

TABLE 3.-- All Bat Captures, 1989

Species	Males	Females	Unknown	Total
<u>Myotis lucifugus</u>	91	9		100
<u>Myotis ciliolabrum</u>	23	18		41
<u>Myotis volans</u>	54	1		55
<u>Myotis evotis</u>	37	21		58
<u>Lasiurus cinereus</u>	11	7	1	19
<u>Eptesicus fuscus</u>	26	7		33
<u>Lasionycteris noctivagans</u>	2	-		2
<u>Antrozous pallidus</u>	2	6		8
Total	246	69	1	316

Few bats were caught in nets at water sources. The greatest number of bats taken in any one night of netting at a water

source was 13. Species captured varied considerably with site. At both Mystery Cave and Little Ice Cave, where the most bats were captured, only species of the genus Myotis were captured, while at Gyp Spring and Sage Creek campground, species diversity was greater. Capture success rates were much higher at caves than at water sources. In all cases, the majority of bats captured were netted within the first three hours of darkness, and very few additional bats were captured when nets were left open beyond this time.

WATER SOURCES

Gyp Spring (T. 9 S., R. 27 E., Sec. 33, Carbon Co., MT; elevation: 1400 m) was netted on nine occasions on the following dates: 17 and 21 June, 24 and 29 July, 6, 15, and 21 August, and 1 and 2 September. Generally, two 5.5 m nets and two 9 m nets were deployed at this site. The spring originates just north of the Wyoming border on BLM land; the resultant stream flows south

TABLE 4.--Bats captured at Gyp Spring

Species	Males	Females	Total
<u>Myotis lucifugus</u>	2	-	2
<u>Myotis ciliolabrum</u>	12	14	26
<u>Myotis volans</u>	2	-	2
<u>Myotis evotis</u>	-	3	3
<u>Lasiurus cinereus</u>	4	2	6
<u>Eptesicus fuscus</u>	3	3	6
<u>Antrozous pallidus</u>	2	6	8
Total	25	28	53

into Wyoming approximately .80 km before entering private land. The area surrounding the spring is characterized by 10 m high red-sandstone outcrops. The vegetation surrounding the spring is representative of the Utah juniper-blacksage ecosystem. Bat species diversity was greatest at this site, and Antrozous pallidus was observed only at this site. Netting was done at the head of the spring, and 53 bats were captured (Table 4).

Bats were netted at Sage Creek campground (T. 7 S., R. 26 E., Sec. 20, Carbon Co., MT; elevation: 1676 m) on the following dates: 1, 2, 8, 19 July; 7, 9, 13, 20, 28 August; 3, 9, 10 September. Bats were netted just east of the Sage Creek campground road on USFS land along a slow moving section of stream. The width of the stream at this site ranged from approximately 5 m to 10 m. Bats could probably drink from Sage Creek along its entire length in this area, but this site represents the only slow moving and open portion of the stream in

the vicinity. The immediate area surrounding the stream is characteristic of the streamside hardwood ecosystem. The surrounding hillside vegetation is sagebrush-grassland. The hills to the south are Douglas-fir forest. One 5.5 m and two 9 m nets were set at this location, and the following bats were taken:

TABLE 5.--Bats Captured at Sage Creek Campground.

Species	Males	Females	Total
<u>Myotis lucifugus</u>	13	2	15
<u>Myotis ciliolabrum</u>	2	1	3
<u>Myotis volans</u>	2	-	2
<u>Myotis evotis</u>	1	-	1
<u>Lasiurus cinereus</u>	5	4	9
<u>Eptesicus fuscus</u>	18	4	22
<u>Lasionycteris noctivagans</u>	2	-	2
Total	43	11	54

Indian Springs (T. 7 S., R. 26 E., Sec. 18, Big Horn Co., MT; elevation: 1636 m) flows into a small (approximately 15 m diameter), shallow pond on the Crow Indian Reservation. Surrounded by willows (Salix spp.) along the northeast, the pond is open along the remainder of its edge. Vegetation immediately adjacent to the pond is sagebrush-grassland. The hillside to the north is Douglas-fir forest while the hills to the south are more open with rocky out-crops. The following bats were taken during two nights of netting on 15 and 25 June using two 9 m nets.

TABLE 6.--Bats Captured at Indian Springs.

Species	Males	Females	Total
<u>Myotis ciliolabrum</u>	2	-	2
<u>Lasiurus cinereus</u>	1	1	2
<u>Eptesicus fuscus</u>	4	-	4
Total	7	1	8

Sage Creek, Warren/Pryor Intersection, (T. 7 S., 25 E., Sec. 9, Bighorn Co., MT; elevation: 1500 m) is located in sagebrush-grassland on the Crow Indian Reservation. One 9 m net was set at this site on 21 June just south of the Pryor Mountain road. No bats were observed.

Bats were netted at Sage Creek (T. 7 S., R. 26 E., Sec. 18, Big Horn Co., MT; elevation: 1600 m) on 22 June using one 5.5 m

net. This sagebrush-grassland site is located on the Crow Indian Reservation. One bat, a male big brown bat (Eptesicus fuscus), was captured.

Bats were netted using one 5.5 m net set over a small flow of water approximately 200 m upstream from the USFS Sage Creek work station (T. 7 S., R. 26 E., Sec. 20, Carbon Co., MT; elevation: 1707 m). The site was netted on five occasions: 9, 28, 29, June; 9, 22 July. This site is a small drainage of open sagebrush-grassland surrounded by Douglas-fir forest. In addition to the bats listed below, a hoary bat (Lasiurus cinereus) was observed flying over the area on several occasions. Table 7 includes one female long-legged myotis (Myotis evotis) captured by hand as it fed on moths at a work station window.

TABLE 7.--Bats Captured at Sage Creek Work Station.

Species	Males	Females	Total
<u>Myotis evotis</u>	1	4	5

The small-footed myotis (Myotis ciliolabrum), was observed at the 'twin hills' guzzler (T. 9 S., 26 E., Sec. 7, Carbon Co., MT; elevation: 1490 m) which is a BLM-constructed fiberglass wildlife watering tank approximately 1.5 m X 1.5 m square. The site is in sagebrush-grassland, and was netted on 29 June; 5, 26 July, using two 9.5 m nets. Although few bats were captured (Table 8), many bats were observed at this location, and were often seen avoiding the net as they attempted to drink. There is no known water within several kilometers of this location. Although no roosting sites were apparent in the area, most bats were observed shortly after sunset, indicating that the bats were arriving at the site from a short distance away. No bats were observed beyond 1.5 hours after sunset.

TABLE 8.--Bats Captured at Twin Hills Guzzler.

Species	Males	Females	Total
<u>Myotis ciliolabrum</u>	6	3	9

The portion of Crooked Creek that was investigated (T. 9 S., R. 27 E., Sec. 2, Carbon Co., MT; elevation: 1550 m) is located on USFS land, and is accessible only by hiking either up or downstream approximately 3 km. The outcrops of the surrounding hillsides are generally too steep to climb into or out of the stream bed in this area. While only one species of bat, Lasiurus cinereus, was captured at this location, many bats were observed flying overhead. Based upon their size, those bats were probably Myotis spp. There is potential for bat roosts in this area due

to the large number of cracks and fissures associated with the canyon walls. Most of the possible roosting sites are a considerable distance up the canyon walls and are not accessible for searches. Few bats were captured, possibly due to the extensive area of the stream that is available to them. Bat abundance in this area would probably be most effectively determined using a bat detector. This site was netted once using two 5.5 m nets on 19 June. The following bats were captured:

TABLE 9.--Bats Captured at Crooked Creek.

Species	Males	Unknown	Total
<u>Lasiurus cinereus</u>	1	1	2

The Helt Ponds (T. 9 S., R. 27 E., Carbon Co., MT; elevation: 1524 m), three in section 25, one in Section 24, are ephemeral, and during the summer of 1989 were dry until 13 July. The eastern most of the ponds in Section 25 was netted on one night, 11 August. No bats were captured, but 5-6 Myotis spp. were observed foraging near the nets shortly after sunset. This site is in the Utah juniper-blacksage ecosystem, and is located on BLM land.

Bent Spring (T. 8 S., R. 25 E., Sec. 1, Carbon Co., MT; elevation: 2285 m) is located on USFS land and consists of a 2 m diameter wooden cattle trough surrounded by open grassland. Douglas-fir forest characterizes the area above the trough on a ridge approximately 500 m uphill from the spring, and rocky canyons are prevalent below. Only one bat was captured here, a male Myotis evotis, on 3 July. Two 5.5 m nets were used.

Listed below are several water sources identified during the 1989 field season that were not investigated extensively. Some of these sites should be netted during subsequent field seasons.

Harsten Flat Pond (T. 7 S., R. 27 E., Sec. 29, Carbon Co., MT; elevation: 2012 m) is located on land owned by the Schwend family. This is a small pond in Montana grassland ecosystem on Harsten Flat. I did not visit this site, but was informed of its existence by USFS employees.

Kruger Pond (T. 8 S., R. 28 E., Sec. 7., Carbon Co., MT; elevation: 2591 m), approximately 70 m by 20 m in size, is located on USFS land in Douglas-fir forest. One Myotis sp. was observed at this site during a rain storm. This pond's proximity to both Mystery Cave and Little Ice Cave suggests that it may be an important foraging site for bats roosting in those caves. The pond should be netted and assessed with a bat detector.

The Tillet ponds (T. 58 N., R 96 W., Sections 22 & 23, Bighorn Co., WY; elevation: 1402 m) are located on private land in sagebrush-grassland. These ponds may be difficult to net, due to their large size and the extensive vegetation surrounding them. These areas should be monitored with a bat detector. The ponds proximity to Gyp Spring suggests that those species caught at Gyp Spring, including the pallid bat, may occur here as well.

Several wells and windmills are indicated on maps along the Gyp Spring road. All of those investigated were dry, and most did not appear to have been used within several years. None of the windmills were functional. Several other developed springs were located in the higher elevations near Bent Spring. All of these springs are very small and apparently operational only during times when livestock are in the area, thus providing an unpredictable source of water for bats.

CAVES

Mystery Cave (T. 8 S., R. 28 E., Sec. 21, Carbon Co., MT; elevation: 2384 m) is located near the south end of East Pryor Mountain on BLM land in Douglas-fir forest. The entrance is approximately 4 m wide and 2 m high. The cave extends over 500 m in depth and possesses many interconnecting passages and rooms. The cave temperature is approximately 2° C at 100 m from the entrance, and the cave is very damp, with running water and small pools present. Two searches of the cave on 14 and 23 August revealed one Myotis lucifugus roosting, and the skeletal remains of nine Myotis spp. Bat droppings were found throughout the cave. The total of 120 bats captured in two nights of netting (on 23 August and 4 September using one 5.5 m and one 9 m net) as they flew from the cave's entrance indicates that the cave serves as a major roosting site for bats. Many bats were observed avoiding the nets, and many that became entangled in the nets escaped before they could be removed, indicating that a considerably larger number of bats were in the cave than were actually captured. While few bats were observed roosting in the cave during the day, some species of bats (e.g. Myotis volans and

TABLE 10.--Bats Captured at Mystery Cave.

Species	Males	Females	Total
<u>Myotis lucifugus</u>	62	7	69
<u>Myotis ciliolabrum</u>	1	-	1
<u>Myotis volans</u>	27	-	27
<u>Myotis evotis</u>	19	4	23
Total	109	11	120

Myotis ciliolabrum) may have roosted in crevices rather than in the open within the cave (Kunz, 1982; Jones et al., 1983) and therefore may not have been visible. Additionally, not all portions of the cave are accessible to search and some bats therefore may not have been detectable. The bats captured are listed in Table 10.

Little Ice Cave (T. 8 S., R. 28 E., Sec. 18, Carbon Co., MT; elevation: 2494 m) is located in Douglas-fir forest on USFS land about 3 km northwest of Mystery Cave. Little Ice Cave is similar in the fractured rock and sinuous character of Mystery Cave, although it lacks the large chambers characteristic of Mystery Cave. Little Ice Cave is cool (approximately 2° C measured at 100 m from the entrance) and damp, although running and standing water was not apparent as in Mystery Cave. The first 16 m beyond the entrance are ice covered year round (Cambell, 1978). This cave was entered once, on 23 August, when three roosting and one dead Myotis lucifugus were located. This cave has several levels, and a fairly small portion of the cave was examined, so additional bats could have been roosting in other portions of the cave and been overlooked. Like Mystery Cave, this cave possesses many crevices where bats could roost. At both Little Ice and Mystery Caves, many of the bats captured had a great deal of soil deposited on their wings and bodies, indicating that they may have been roosting in crevices where their bodies were in contact with the cave surfaces. Sixty-three bats were captured on 9 August using one 9 m and one 5.5 m net (Table 11).

TABLE 11.--Bats Captured at Little Ice Cave.

Species	Males	Females	Total
<u>Myotis lucifugus</u>	14	-	14
<u>Myotis volans</u>	23	1	24
<u>Myotis evotis</u>	15	10	25
Total	52	11	63

Mystery Cave and Little Ice Cave exhibited the greatest amount of summer bat activity during 1989. Of the total of 316 bats captured during this study, 183 were netted at these two locations. The extensive nature of these two caves, with their cool temperatures and dampness, should provide appropriate winter hibernating habitat for bats (Tuttle and Stevenson, 1978). Based upon the large number of bats captured, it is apparent that the caves are used extensively during the summer. However, the cool temperatures probably preclude the use of the cave by female bats (Kunz, 1982, Anthony, et al. 1981). Of the 183 bats captured at Little Ice Cave and Mystery Cave, only 22 were females and none

were lactating. These sex ratios vary significantly from an expected 1:1 (Table 12).

TABLE 12.--Sex and Chi-Square Values for Bats Captured at Mystery Cave and Little Ice Cave.

Species	Males	Females	Total	Chi-Sq
<u>Myotis lucifugus</u>	76	7	83	56.9*
<u>Myotis ciliolabrum</u>	1	-	1	-
<u>Myotis volans</u>	50	1	51	47.0*
<u>Myotis evotis</u>	34	14	48	9.6*
Totals	161	22	183	

* Significant at $P < .05$

Located on an arid ridge of Utah juniper-blacksage on BLM land, Four-eared Bat Cave (T. 9 S., R. 28 E., Sec. 27, Carbon Co., MT; elevation: 1537 m) is known to have been used by Plecotus townsendii as a winter hibernaculum in the past. Aside from a small amount of bat droppings, no bats were detected in this cave in 1989. Four-eared Bat Cave is less extensive than either Little Ice or Mystery Cave, with two large rooms extending inward approximately 70 m, and the cave is dryer and warmer (approximately 6° C at 25 m from the entrance), possibly due to its lower elevation relative to Mystery Cave and Little Ice Cave. The opening of the cave is approximately 2 m high by 6 m long. One 5.5 m and one 9 m net was set at this cave on 29 August. No bats were captured or observed.

Bats were not netted at the caves listed below, and several of them were not visited. In those cases I rely on descriptions from Cambell (1978) for discussion of bat roost potential.

Royce Cave (9 S., R. 28 E., Sec. 6, Carbon Co., MT; elevation: 1878 m) is located on BLM land in rock outcrop-forest, and was investigated on 30 August. The cave is warm (approximately 6° C), but damper than Four-eared Bat Cave. Some bat droppings were observed in this cave, but no other bat sign was noted. This cave is moderately deep (approximately 75 m) with a large chamber at the end of a 9 m crawl space. The cave may provide appropriate roosting habitat for bats, and should be investigated further.

Salt Lick Cave (T. 8 S., R. 28 E., Sec. 17, Carbon Co., MT; elevation: 2485 m) is located on BLM land in the Montana grassland ecosystem. The cave is approximately 35 m deep and very open, providing minimal shelter and thermal stability in winter. The cave may be used as a summer roost, but no bat sign was

detected in the cave in 1989. The temperature of this cave was not recorded.

Big Ice Cave (T. 8 S., R. 27 E., Sec. 3, Carbon Co., MT; elevation: 2295 m) is located on USFS land in Douglas-fir forest. The cave is cold (approximately 3° C) and ice is present in the cave throughout the year (Cambell, 1978). This cave is approximately 50 m deep, and may be used as a winter hibernacula, but no bat sign was detected there. The cave is a popular tourist attraction, and has been subject to a great deal of disturbance.

Four by Four Cave (T. 9 S., R. 28 E., Sec. 21, Carbon Co., MT; elevation: 1662 m) is a small 8 m vertical sink on BLM land in Utah juniper blacksage habitat. No bat sign was observed in this cave, and given the cave's small size and openness, its use by bats seems unlikely.

Cambell (1978) states that the temperature of Frogg's Fault Cave (T. 9 S., R. 28 E., Sec. 16, Carbon Co., MT; elevation: 1835 m) is 4.4 C, which is ideal for Plecotus townsendii roosting and hibernacula sites (Genter, 1986). The cave is located on BLM land in rock outcrop-forest. I did not visit this cave, as technical equipment is required in order to enter it. It is possible that it may be used by bats during the summer, and thus netting or the use of a bat detector at the cave's entrance is recommended.

Keyhole Cave (T. 8 S., R. 27 E., Sec. 35, Carbon Co., MT; elevation: 1707 m) is located in a steep portion of the east canyon wall of Crooked Creek. The cave is on USFS land in rock outcrop-forest. I attempted to access Keyhole Cave from below, but was unsuccessful. It is unclear whether the cave can be reached without technical gear. The cave opening is 26 m high and 7 m wide, but the cave extends only approximately 20 m. While the cave may be used by bats during the summer, its open nature and shallow depth would likely allow extreme temperature fluctuations making the cave unsuitable as a winter hibernaculum.

Crater Ice Cave (T. 8 S., R. 27 E., Sec. 6, Carbon Co., MT; elevation: 2649 m) is located on USFS land in subalpine forest and meadow, and Cambell (1978) states that the temperature of the cave is 1 C. Crater Ice Cave consists of one 50 m diameter room with 70 m of passage. While this cave may be used by bats during the summer, the entrance is plugged by snow in winter into late spring, and may not be usable by bats in winter. Several mining shafts (T. 9 S., R. 27 E., Sec's. 17, 8, 9, & 4, Carbon Co., MT) along the Red Pryor Mountain road on BLM land were given a cursory investigation during the 1989 field season. All are deep (more than 100 m deep). The shafts are cool (exact temperature was not recorded), and damp, some with standing water. I did not travel into these beyond approximately 30 m,

and within that distance observed no bat sign. Bats could roost in the deeper portions of the shafts, however, and these shafts could provide good winter roosting habitat. For the most part, the shafts lack crevices within them, and most roosting bats would be exposed openly in the shaft. These sites would probably be difficult to reach during the winter, but it may be useful to search them in spring and/or to erect nets at their entrances during subsequent field seasons.

Several days were spent in BCNRA, and while no netting was done, several Myotis spp. were observed foraging over the lake, and three Myotis volans with young were found on 17 July in the rafters of the old post office at Hillsborro, MT.

The Bighorn Canyon National Recreation Area (BCNRA), to the east of the Pryor Mountains, possesses potential foraging and roosting habitat for bats. Two specimens of the spotted bat are known from the area. A spotted bat was found dead near the Yellowtail Visitor Center near Fort Smith, Montana, in 1981, and a live spotted bat was photographed at south district visitor center near Lovell, Wyoming in 1982 (T. Peters, pers com.). The tall (300 m) cliffs in this area provide potential habitat for this and other species of bats, and is similar to that described as spotted bat roosting areas (Woodsworth et al., 1981).

DISCUSSION

The discovery during the summer of 1989 of evidence of breeding by the pallid bat in Montana was significant. This species was known in Montana from only one specimen taken at Gyp Spring (Shryer and Flath, 1980) and its status in Montana is uncertain. Eight pallid bats were captured at Gyp Spring during the summer, and four of those were lactating females. This presents strong evidence that this species breeds in Montana. Further, a lactating female was captured south of Ashland, MT approximately 160 km northeast of Gyp Spring. This indicates that this species is not restricted to the Pryor Mountain area, and is more widespread in the state. During the next field season, an attempt will be made to locate more pallid bats in the Gyp Spring area, and to locate roosting sites. On a broader scale, beyond the scope of this study, it would be desirable to search for this species throughout south-central Montana, especially between the Pryor Mountain Area and Ashland, in order to determine its distributional range in Montana.

|| Pallid
Bat
near
Ashland

Since the number of bats captured at most sites was relatively low (except at Mystery Cave and Little Ice Cave) is necessary to implement the use of a bat detector to complement mist netting. Bat detectors, while limited in their accuracy in identifying all species, can give a more accurate account of bat activity and abundance at sites than does mist netting (Fenton et al., 1987).

Mystery Cave has been gated by the BLM to prevent unauthorized access in an attempt to protect cave resources, although during the summer of 1989 the gate was found to be broken. The U.S. Forest Service may wish to consider gating Little Ice Cave, given the caves extensive use by bats. If Four-eared Bat Cave is found to be inhabited by Plecotus townsendii at any time of the year, the BLM may wish to consider similar action, as this species is known to be very sensitive to human disturbance (Genter, 1986). Such gates should be less susceptible to vandalism than the gate at Mystery Cave. While access to Four-eared Bat Cave is more difficult than access to the caves discussed above, the sensitive nature of Plecotus townsendii may warrant special consideration in protecting its roosting sites and hibernacula.

Gyp Spring is an important foraging site for several species of bats, including the pallid bat. The BLM currently fences only the head of the spring. It would greatly reduce resource conflicts between grazing and wildlife and riparian management to fence the riparian community downstream from this spring as well. It would be beneficial for all species of wildlife using this unique riparian area if livestock use were restricted.

RECOMMENDATIONS FOR FURTHER WORK

An examination of the river between Barry's Landing and Devil's Overlook revealed numerous inlets extending from the main river body which would provide calmer water for foraging bats. The ends of some of these fingers could be netted, but netting in the river bottom would be difficult. Euderma maculatum would be best detected in this area by listening for its echolocation calls, which are audible to the unaided human ear (Woodsworth et al., 1981). A bat detector could be used to detect this and other species.

Two ponds on the plateau above the river near Layout Creek Ranger Station could provide good netting opportunities, as would sewage lagoons near the Horseshoe Bend area and ponds on private land in the same area. The ponds at Layout Creek, as well as being near the river, are approximately 5 km from Mystery Cave and may be used by some of the bats roosting there. Another potential netting spot in the area is the Tillet Springs Fish Rearing Station northeast of Horseshoe Bend.

Both Mystery Cave and Little Ice Cave appear to be important habitat for bats. It should be determined if use of these caves by bats is continuous or seasonal. Netting should be conducted throughout the spring, summer, and fall, and visit these caves during the winter to determine if bats use the caves as hibernacula. Very little is known about the wintering habits of bats in Montana, and in the case of Myotis evotis, nothing is known about its hibernating habits throughout its range (Manning

and Jones, 1989). Four-eared Bat Cave should be thoroughly searched for sign of use by bats, especially use by Plecotus townsendii. It should be visited during the winter and in early spring, since this summer's investigation suggests that it may not be used as a summer roost. Syke's Cave should be located and searched for bat sign, and Royce Cave should be searched more thoroughly and netting should be done at its entrance. The several mining tunnels located should be investigated more thoroughly. More complete data from all caves and mining tunnels needs to be collected including humidity readings and temperature readings at various locations within the caves taken throughout the season. A more complete vegetation survey conducted at each site, as well as more information collected on slope and aspect of the cave and tunnel entrances will be necessary to characterize the cave structures and habitat.

LITERATURE CITED

- Anthony, E.L.P., M.H. Stack and T.H. Kunz 1981. Night roosting and the nocturnal time budget of the little brown bat, (Myotis lucifugus): Effects of reproductive status, prey density, and environmental conditions. *Oecologia*, 51:151-156.
- Barclay, R.M.R., and G.P. Bell 1988. Marking and observational techniques. Pp 59-76 in *Ecological and Behavioral Methods for the Study of Bats* (T.H. Kunz, ed.). Smithsonian Instit. Press, Washington, D.C., 533 pp.
- Cambell, N.P. 1978. *Caves of Montana*. Montana College of Mineral Science and Technology. Butte, MT., 169 pp.
- Fenton, M.B. 1988. Detecting, recording, and analyzing vocalizations of bats. in *Ecological and Behavioral Methods for the Study of Bats*. (T.H. Kunz, ed.). Smithsonian Instit. Press, Washington, D.C., 533 pp.
- Genter, D.L. 1989. Townsend's big-eared bat, Plecotus townsendii. pp. 103-104 in *Rare, sensitive, and threatened species of the Greater Yellowstone Ecosystem* (T.W. Clark, A.H. Harvey, R.D. Dorn, D.L. Genter, and C. Groves, eds.). Northern Rockies Conservation Cooperative, Montana Natural Heritage Program, The Nature Conservancy, and Mountain West Environmental Services. 153 pp.
- Genter, D.L. 1986. Wintering bats of the upper Snake River Plain: occurrence in lava-tube caves. *Great Bas. Nat.* 46:241-244.
- Griffith, L.A., and J.E. Gates 1985. Food habits of cave-dwelling bats in the central Appalachians. *J. Mamm.*, 66:451-460.
- Hall, E.R. 1981. *The Mammals of North America*. Vol. 1. Wiley and Sons, New York., 600 pp. plus index.
- Hoffmann, R.S. and D.L. Pattie 1968. *A Guide to Montana Mammals: Identification, Habitat, Distribution and Abundance* 1968. ASUM, Montana., 133 pp.
- Jones, J.K., Jr., D.M. Armstrong, R.S. Hoffmann, and C. Jones. 1983. *Mammals of the Northern Great Plains*. University of Nebraska Press. 379 pp.

- Kunz, T.H. 1973. Resource utilization: Temporal and spatial components of bat activity in central Iowa. J. Mamm., 54:14-32.
- Kunz, T.H. 1982. Roosting Ecology. Pp. 1-46, in Ecology of Bats (T.H. Kunz, ed.). Plenum Press, New York., 425 pp.
- Kunz, T.H. and A. Kurta 1988. Capture methods and holding devices. Pp. 1-29, in Ecological and Behavioral Methods for the Study of Bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C., 533 pp.
- Laval, R.K. 1970. Banding returns and activity periods of some Costa Rican bats. Southwest. Nat. 15:1-10.
- Manning, R.W., and J.K. Jones, Jr., 1989. Myotis evotis. Mamm. Spec., 329:1-5.
- MTNHP 1989. Animal Species of Special Concern in Montana. Montana Natural Heritage Program, Helena, MT. 10 pp.
- Racey, P.A. 1988. Reproductive assessment in bats. Pp 31-45 in Ecological and Behavioral Methods for the Study of Bats (T.H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C., 533 pp.
- Shryer, J. and D.L. Flath 1980. First record of the pallid bat (Antrozous pallidus) from Montana. Great Basin Nat. 40:115.
- South, P. 1980. Pryor Mountain Ecosystems. 54 pp. U.S. Forest Service.
- Tuttle, M.D. 1979. Status, causes of decline, and management of endangered gray bats. J. Wildl. Manage. 43:1-17.
- Tuttle, M.D., and D.E. Stevenson 1978. Variation in the cave environment and its biological implications. Pp. 108-121. in Proceedings of the National Cave Management Symposium. (R. Zuber, J. Chester, S. Gilbert, and D. Rhodes, eds.). Adobe Press, Albuquerque, 140 pp.
- von Frenckell, B. and R.M.R. Barclay 1987. Bat activity over calm and turbulent water. Can. J. Zool., 65:219-222.
- Woodsworth, G.C., G.P. Bell, and M.B. Fenton 1981. Observations of the echolocation, feeding behavior, and habitat use of (Euderma maculatum) (Chiroptera: Vespertilionidae) in south central British Columbia. Can. J. Zool., 59:1099-1102.